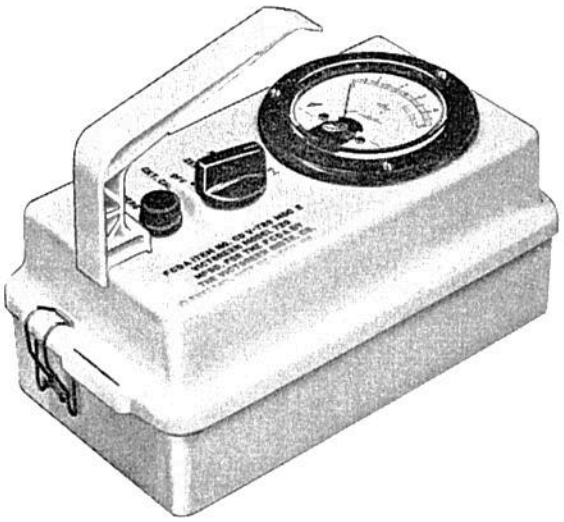
section 12

CD V-720-2



specifications:

- Ranges: 0-5, 0-50, 0-500 r/hr
- Sensing Element: Ionization Chamber
- Accuracy: ±15% of true dose rate from cobalt 60 gamma radiation
- Batteries: Two 1-1/2 volt NEDA 13
  One 22-1/2 volt NEDA 215
- Dimensions: approx. 9" long x 4-3/4" wide x 6-1/2" high including handle
- Weight: approx. 2-3/4 lbs. including batteries

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GENERAL DESCRIPTION

Introduction

The Victoreen CD V-720 model 2 is a portable ionization chamber instrument designed for the detection of high levels of beta and gamma radiation. The ionization chamber is located inside the case in the lower front portion of the instrument. The entire instrument and its accessories include an indicating meter, ionization chamber, and carrying strap. The bottom of the instrument case contains a sliding beta shield to permit discrimination against beta particles if desired.

Meter and Controls

The CD V-720-2 uses a ruggedized, sealed meter to meet the instrument requirements for water-tightness, shock, and vibration resistance. Two controls are provided. One control is a range selector switch which turns the instrument on, checks its operation, and selects the desired sensing range. The other control is a zero control which is used to adjust the instrument to assure proper reading. Zeroing compensates for temperature variations and battery aging.

Adjustments and Readings

Zero Adjust

Turn the instrument on by turning the range switch from OFF to the ZERO position. Wait about a minute to allow the electrometer tube to warm up, then orient the ZERO control until the meter indicates zero. The instrument must be zeroed before attempting to check the circuitry or use any of the sensing ranges.

Circuit Check

Turn the range switch from the ZERO position to the CIRCUIT CHECK position. The range switch must be held against the stop in this position since the switch is spring-loaded to return to OFF. The meter should read in or above the red outlined section labeled CIRCUIT CHECK. Weak or dead batteries are often the cause of inability to zero or circuit check the instrument. Refer to the Trouble Shooting Guide for corrective measures if a low reading is obtained.

The zeroing and circuit check operations may be performed at any time whether the instrument is in a radiation field or not. However, the instrument must be zeroed before making the circuit check.

Sensing Ranges

The radiation sensing ranges are activated by turning the range switch to X100, X10, and X1. Unless radiation is present, the meter should return to within 3 minor scale divisions of zero after allowing a few seconds for transient currents to dissipate.

Table 12-1 lists switch positions and the corresponding meter readings. Figure 12-1 shows the meter face. Readings should not be taken with the

Switch Position	R/hr
X1	0-5
X10	0-50
X100	0-500

Table 12-1. Switch Positions vs Meter Readings

pointer indicating in the lower 10% of the scale. Turn to the next most sensitive range until the pointer indicates in the upper 90% of the scale.

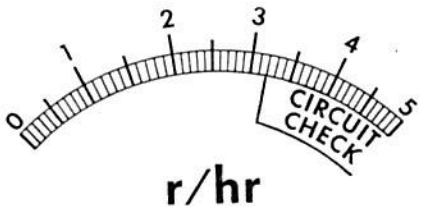

Figure 12-1. Meter Face

A sliding beta shield is provided at the bottom of the instrument to assist in determining the type of radiation being detected. The shutter has three positions:

1. Completely closed — gamma radiation sensitivity only.
2. 25% open — gamma and beta radiation.
3. Completely open — maximum sensitivity to beta radiation.

The beta shutter should be kept closed when the instrument is not in use to protect the beta window from damage.

Batteries

The CD V-720-2 is powered by two 1-1/2 volt "D" size batteries and one 22-1/2 volt "B" battery. The batteries will operate the instrument continuously for over 150 hours and much longer on an intermittent basis. Refer to Appendix A for acceptable types and makes of batteries.

Installation

Follow the Disassembly Instructions through step 2 to open the case. Insert the batteries in the appropriate clips according to the polarity markings on the battery label card. Figure 12-2 shows the batteries installed properly. Close the case by aligning the two case sections, pressing them firmly together, and closing the pull catches.

Figure 12-2. Battery Installation

Replacement

The batteries should always be checked before making further instrument adjustments or repairs. The batteries may be checked with a voltmeter while installed in the instrument. With the range switch in the ZERO position, the 1-1/2 volt batteries should read at least 1.2 volts and the 22-1/2 volt battery should read 17 volts or higher. The batteries may also be removed and checked with a battery tester.

Good batteries are required since a direct relationship exists between battery voltage and instrument response to radiation. Instruments with very weak batteries may give errors in radiation response even though satisfactory circuit check and zero adjustment may be obtained.

Electronic Circuitry

The electrical components and wiring are enclosed in a watertight compartment. The circuitry serves to measure the minute current from the ionization chamber which indicates the presence of ionizing radiation.

Input Circuit

The minute ionization current from the chamber collector at 5 R/hr — about 0.00005 microamperes — flows through a 25,000 megohm resistor and develops a voltage of about 1.2 volts across the resistor. This voltage is also applied to the grid of the electrometer tube, V1, which is connected as a triode. The range switch changes high megohm resistor values to keep the voltage applied to the electrometer tube grid within the proper operating range.

Measuring Circuit

A 50 microampere meter is used to measure the change in current through the electrometer tube. The static plate current is cancelled by running a reverse current, supplied by the filament battery BT1, through the meter. The magnitude of this current is fixed by the bucking resistor R3. The zero control, R4, changes the bias on the electrometer tube. When R4 is adjusted properly, the meter reads zero. High megohm resistors R5, R6, and R7 are input resistors for the electrometer tube on the various ranges. When the ionization chamber is exposed to radiation, a voltage is developed across the high megohm resistor chosen by the range switch. This voltage results in an increase in tube current and the indicating meter reads upscale in proportion to the radiation intensity.

Resistors R8, R9, and R10 are calibrating potentiometers which shunt some of the current around the meter on the various ranges. In the CIRCUIT CHECK position, the bias on the electrometer tube is changed, making the meter read upscale.

SERVICING

Precautions

High Impedance Circuitry

The high megohm resistors, electrometer tube, ceramic switch wafer, and chamber feed-thru insulator constitute the high impedance circuitry of the CD V-720-2. Any accumulation of dirt or grease on these parts will render the instrument inoperable. These parts must not be handled except in accordance with instructions in Section 1 of this Manual.

Electrometer Tube

When checking the electrometer tube filament, use an ohmmeter which has an output current of less than 10 ma when used to measure resistances of about 100 ohms. Current in excess of 10 ma may destroy the filament. No damage will result from use of the ohmmeters described in Appendix B.

Ionization Chamber

The beta window of the chamber is a thin stainless steel disc. If the window should be punctured, the seal of the chamber is destroyed and the readings are no longer independent of altitude, temperature, and humidity. Keep the beta shield closed when servicing the instrument.

Mounting Screws

The circuit plate mounting screws are held in metal inserts in each of the four case top legs. Do not overtighten these screws or the inserts may break away from the plastic.

Disassembly Instructions (see figure 12-3)

1. Open the pull catch at each end of the instrument case.
2. Set the instrument on its side on a table and press on the top and bottom sections. Repeat this alternately on both sides until the case sections are separated.
3. Remove the batteries.

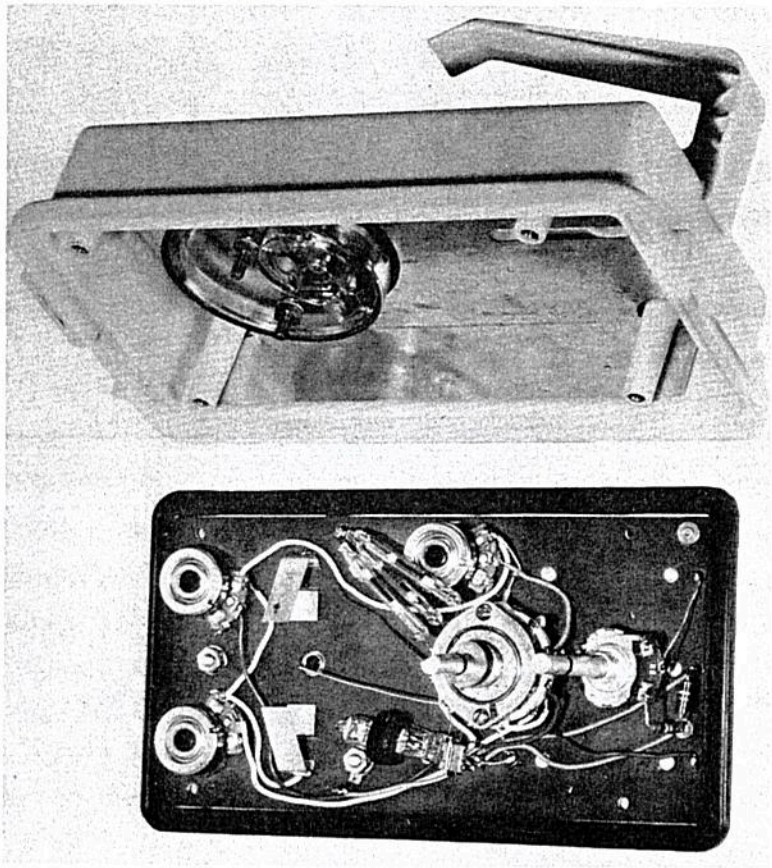

Figure 12-3. Disassembled Instrument

4. Open the circuit box by removing the four screws on the bottom of the circuit plate.
5. Remove the knobs from the case top by loosening the set screws.
6. Press firmly on the top of the two exposed shafts to remove the circuit plate.
7. Remove the circuit shield for access to the electronic circuitry.

Preventive Maintenance

It is recommended that preventive maintenance procedures be carried out once a month when the instrument is in use and about once every six months when the instrument is in storage.

1. Remove the batteries, clean the battery contacts and battery terminals, and remove any corrosion present.
2. Reinstall the batteries making certain that all batteries make good contact and exceed the minimum operating voltages.
3. Perform the Zero and Circuit Check operations.
4. If the instrument is to be shipped or stored, remove the batteries and set the range switch to one of the sensing ranges. This will shunt the meter and minimize damage from movement of the pointer during shipment or storage.

Do not use solvents when cleaning the plastic case. To clean the case, use only soap and water. If the batteries have leaked, remove the case bottom and fill only the battery compartment bottom with warm water. The battery spillage will be loosened in a short time and can be rinsed out. Dry the case thoroughly before reassembling. HUMI-SORB desiccant or its equivalent should be packed in the case bottom of all ionization chamber type instruments upon receipt at warehouses and upon completion of servicing or periodic maintenance.

Repairs

Electrometer Tube Replacement

1. Follow the Disassembly Instructions through step 7.
2. Unsolder the grid lead of the tube.

3. Grasp the four leads with needle-nosed pliers and pull them carefully away from the socket.
4. Push the top of the tube toward the socket to remove the tube from the rubber grommet. Do not push the tube base through the grommet since this will contaminate the base with silicone grease.

Coat the top of the new electrometer tube with silicone grease before installing. Use needle-nosed pliers on the leads to avoid contaminating the tube with fingerprint oils. Do not allow the grid lead to touch any wires or components since this can cause insensitivity or upscale readings.

Switch Replacement

The range switch is bolted to the circuit plate and may be removed in a conventional manner. Remove the two nuts on the bottom of the circuit plate and unsolder as many leads as necessary to remove the switch.

Case Closure Repair

A field modification for the CD V-720-2 has been furnished in kit form. The kit is composed of two back-up plates, two repair clips, four 3-48 machine screws, and two sleeves. (See figure 12-4)

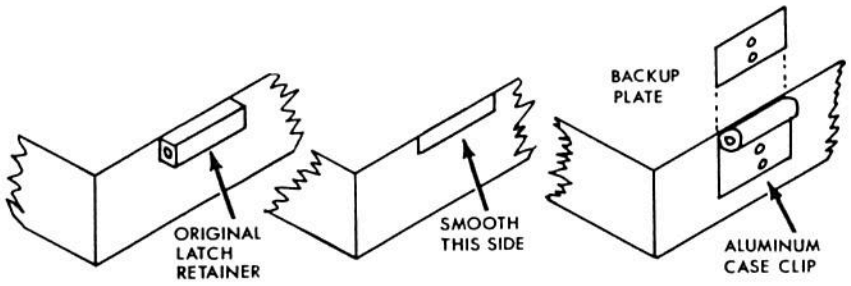

Figure 12-4. Case Closure Repair

1. Remove the plastic case closure brackets with a hack saw, sharp knife, file, or grinding wheel. Smooth the surface with a file or sandpaper.
2. Position the clip with the turned edge flush with the top edge of the case bottom and drill two holes for screws with a 1/8" drill. Attach the clip

4. Open the circuit box by removing the four screws on the bottom of the circuit plate.
5. Remove the knobs from the case top by loosening the set screws.
6. Press firmly on the top of the two exposed shafts to remove the circuit plate.
7. Remove the circuit shield for access to the electronic circuitry.

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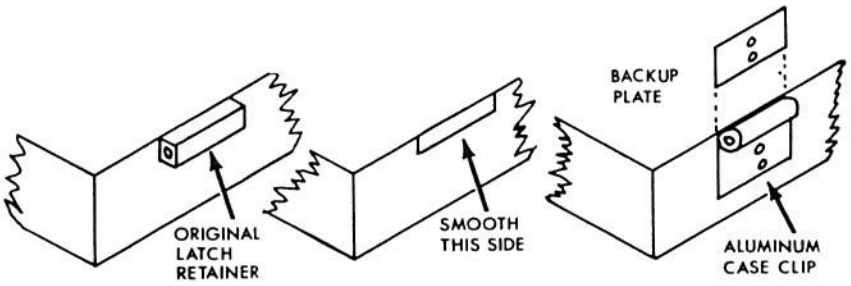


Figure 12-4. Case Closure Repair

1. Remove the plastic case closure brackets with a hack saw, sharp knife, file, or grinding wheel. Smooth the surface with a file or sandpaper.
2. Position the clip with the turned edge flush with the top edge of the case bottom and drill two holes for screws with a 1/8" drill. Attach the clip

with two 3-48 machine screws using the threaded plate inside the case bottom.

3. Install the case fastener and sleeve.
4. Coat the plate, screws, and area around the plate on the inside of the case with radio service cement to insure watertightness.

Trouble Shooting

The information in this section is presented as an aid to the service technician in determining the causes of specific instrument faults. The Trouble Shooting Guide lists the most probable causes of instrument failure together with suggestions for corrective action. This should be consulted and followed after the following preliminary steps have been taken:

1. Follow the Disassembly Instructions through step 2.
2. Check the batteries. Make sure they exceed the minimum voltage for proper operation of the instrument.
3. Complete the disassembly procedure.
4. Check for broken or shorted wires.
5. Check for broken or otherwise damaged components.

Table 12-2, Test Point Chart, and figure 12-5, Location of Components and Test Points, eliminate the need for circuit tracing when making voltages and resistance measurements. The Test Points are referred to in the NOTES column of the Trouble Shooting Guide, and are also found on the schematic circuit diagram.

TROUBLE SHOOTING GUIDE

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
ZERO	Dead	Poor connection to battery	Repair connection	
		Meter defective	Repair or replace meter	
		Meter terminals not making contact to clips	Reposition clips	
		Open contact on S1C	Repair switch	Check continuity at B - E
	Downscale	Poor connection to battery	Repair connection	
		V1 filament open or poor contact to socket	Replace V1 or repair connection	Check resistance at B - G
		R4 defective	Repair or replace R4	
	Upscale	Battery inserted backwards	Reverse battery	
		Poor connection to battery	Repair connection	Check voltage at F
		Open contact on S1D	Repair switch	Check continuity at D - ▲

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
ZERO (cont'd)	Upscale (cont'd)	R4 defective	Repair or replace R4	
		V1 shorted	Replace V1	
	Erratic	Meter defective	Repair or replace meter	
		Meter terminals not making good contact to clips	Reposition clips	
		Open contact on S1A	Repair switch	Check continuity at J - ▲
		Open contact on S1D	Repair switch	Check continuity at D - ▲
		R4 defective	Repair or replace R4	
		V1 defective	Replace V1	
CIRCUIT CHECK	Below Red Area	Batteries low or making poor contact	Replace batteries or repair contact	
		Open contact on S1A	Repair switch	Check continuity at J - H
		V1 transconductance low	Replace V1	
		R12 defective	Replace R12	Check resistance at H - ▲
	Dead	Open contact on S1C	Repair switch	Check continuity at B - E

Radiation Sensing Ranges	Upscale on one or more ranges, but greatest effect on X1 range	Moisture contaminating high impedance components	Dry out with heat (150°F or less) or desiccant	
		Chamber defective	Repair or replace chamber	Remove chamber and check instrument again
		V1 defective	Replace V1	Check V1 for grid current
	Pegs upscale on all ranges	V1 defective	Replace V1	Check V1 for shorts
	No response to radiation on all ranges	Chamber defective	Replace chamber	
		V1 defective	Replace V1	Check V1 for transconductance
	Low response to radiation on all ranges	Chamber defective	Repair or replace chamber	
		V1 defective	Replace V1	Check V1 for transconductance
	No response to radiation on only one range	Calibration control turned fully counterclockwise	Recalibrate on particular range	
		High megohm resistor dirty or defective	Clean or replace high megohm resistor	Check resistances at J - ▲
		Open contact on S1A	Repair switch	Check resistances at J - ▲
	Low response to radiation on only one range	Calibration disturbed	Recalibrate	
		High megohm resistor dirty or defective	Clean or replace high megohm resistor	Check resistances at J - ▲

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Radiation Sensing Ranges (cont'd)	Erratic response to radiation	Dirt on ceramic switch wafer	Clean switch	
		Chamber defective	Replace chamber	
		Meter terminals not making good contact to clips	Reposition clips	
		Meter defective	Repair or replace meter	
		S1A defective	Repair switch	Check resistances at J - ▲
		S1B defective	Repair switch	Check continuity at B - L B - A B - C
		V1 defective	Replace V1	

CD

RESISTANCE CHART

Remove batteries before checking resistances. Values ±20% except as noted.

Component	Points	Range Switch Position	Resistance (ohms)
S1A and hi-megs	J - ▲	ZERO	0
	J - H	CIRCUIT CHECK	0
	J - ▲	X100	2.5×10^{8} ±10%
	J - ▲	X10	2.5×10^{9} ±10%
	J - ▲	X1	2.5×10^{10} ±10%
S1B	B - C	X100	0
	B - A	X10	0
	B - L	X1	0
S1C	B - E	All except OFF	0
S1D	D - ▲	All except OFF	0
V1 filament	B - G	Any	110

VOLTAGE CHART

Voltages measured with respect to point ▲ with instrument correctly zeroed on ZERO range. Use a 20,000 ohms per volt meter. All values ±20%.

Point	Voltage	Voltmeter Range
F	10.5	12
G	4.4	12
K	2.9	12
H	1.0	3

Table 12-2. Test Point Chart

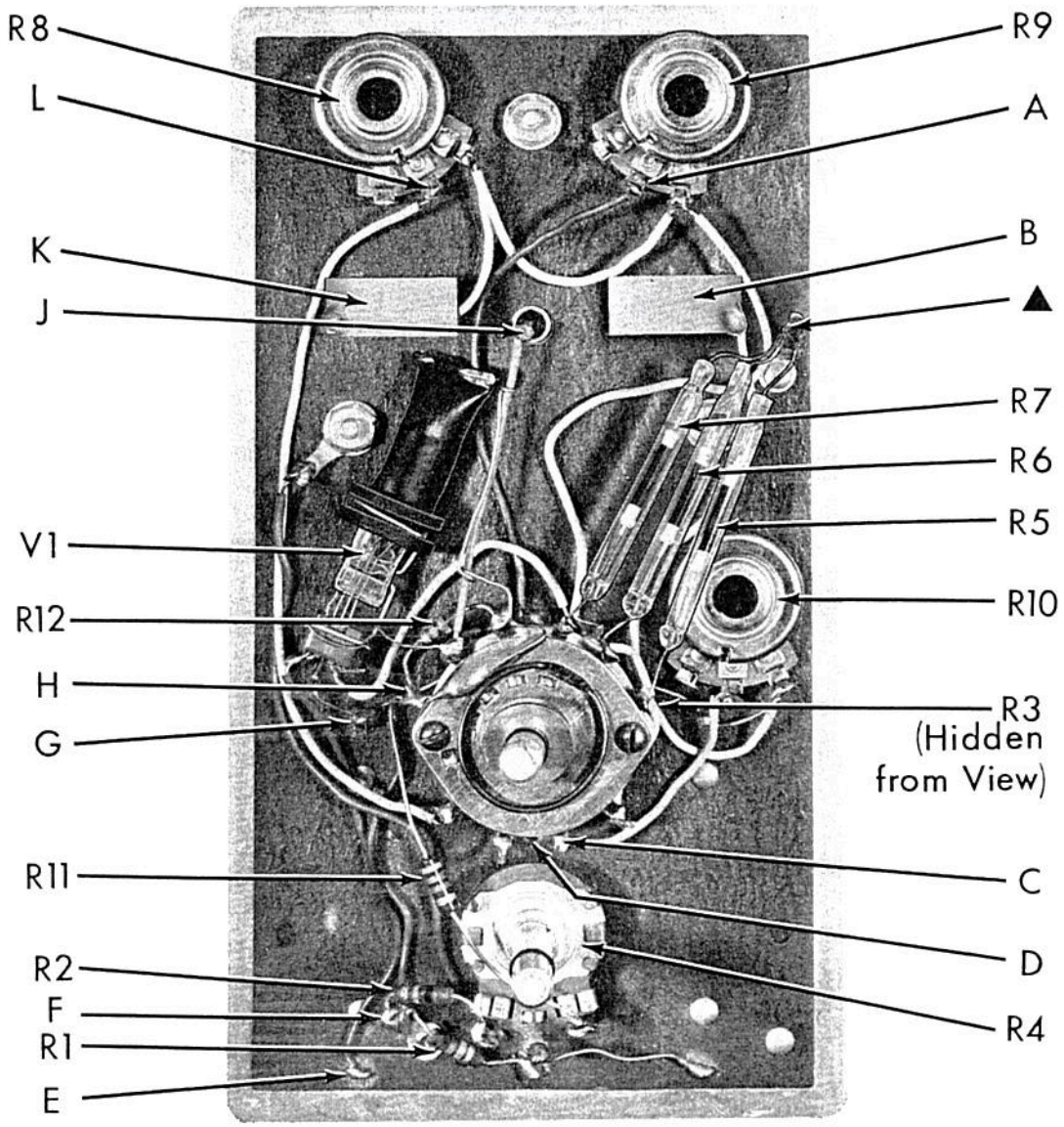
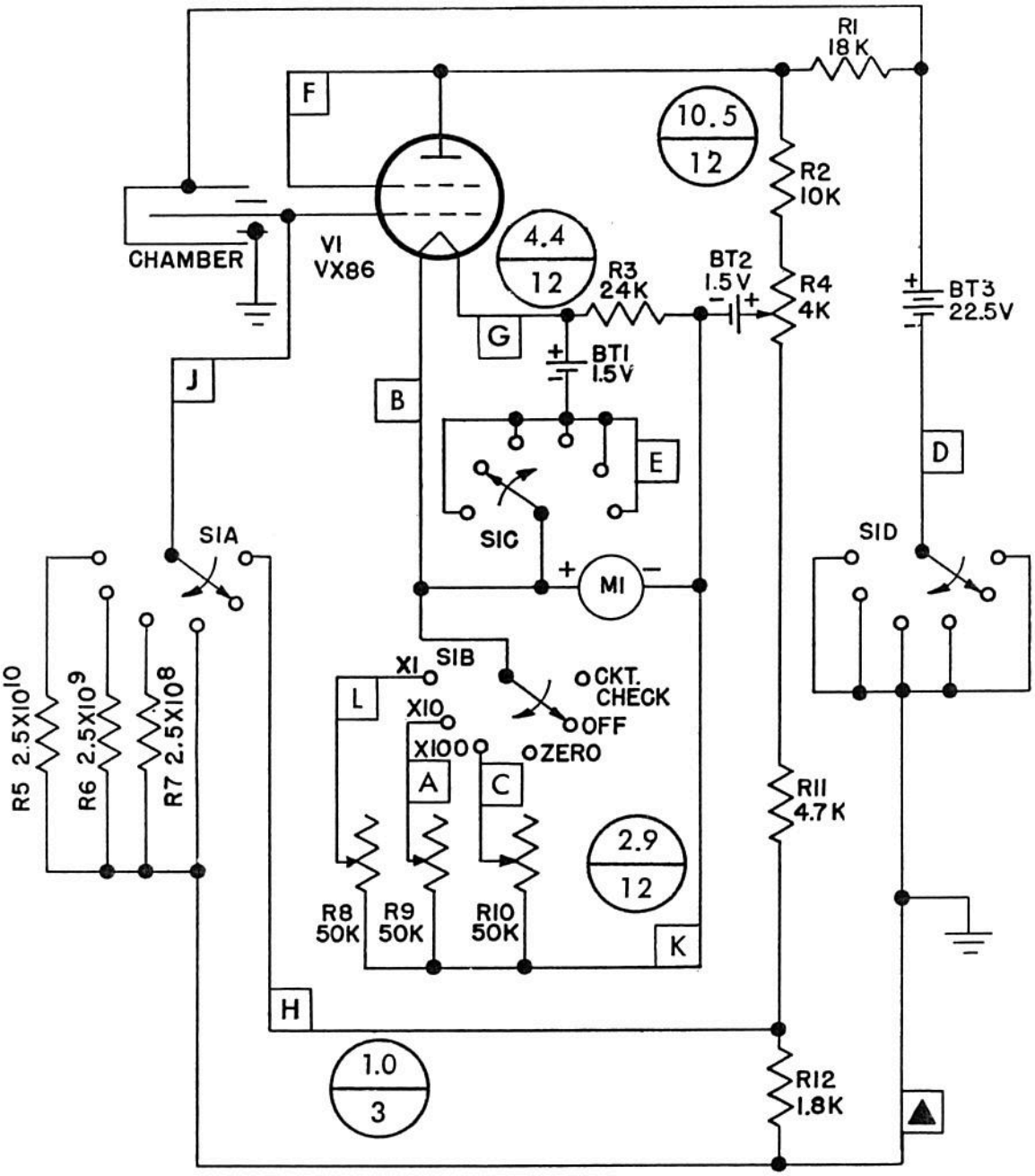


Figure 12-5. Location of Components and Test Points



NOTES:

All resistance values in ohms

[A] indicates Test Points

VOLTAGE RANGE

Voltages measured with respect to point ▲ with instrument correctly zeroed on ZERO range. Use a 20,000 ohms per volt meter

Figure 12-6. Schematic Circuit Diagram

PARTS LIST

Electrical Components

Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
BT1	Battery "D" size 1-1/2V NEDA 13	Filament power supply	Union Carbide 950	16-4
BT2	Battery "D" size 1-1/2V NEDA 13	Grid bias	Union Carbide 950	16-4
BT3	Battery hearing aid type 22-1/2V NEDA 215	Plate supply	Union Carbide 412	356-38
M1	Meter 0-50 ua	Indicating	Phaostron Inst. & Elec.Div.	720-8
R1	Resistor 18K 1/2W ±10%	Voltage divider	International Resistance Co.	185-360
R2	Resistor 10K 1/2W ±10%	Voltage divider	International Resistance Co.	185-253
R3	Resistor 24K 1/2W ±5%	Plate current bias	International Resistance Co.	185-305
R4	Potentiometer 4K ±20%	Zero adjust	Centralab	710-77
R5	Resistor 2.5×10^{10} ohms ±10% (white)	Grid resistor X1 range	Victoreen Instrument Co. 185-1017	185-1017

Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
R6	Resistor 2.5×10^9 ohms ±10% (blue)	Grid resistor X10 range	Victoreen Instrument Co. 185-1134	185-1134
R7	Resistor 2.5×10^8 ohms ±10% (green)	Grid resistor X100 range	Victoreen Instrument Co. 185-1014	185-1014
R8	Potentiometer 50K ±30%	Calibration adjust X1	Stackpole Carbon Co.	710-41
R9	Potentiometer 50K ±30%	Calibration adjust X10	Stackpole Carbon Co.	710-41
R10	Potentiometer 50K ±30%	Calibration adjust X100	Stackpole Carbon Co.	710-41
R11	Resistor 4.7K 1/2W ±10%	Voltage divider	International Resistance Co.	185-175
R12	Resistor 1.8K 1/2W ±5%	Circuit check	International Resistance Co.	185-347
S1	Switch	Range switch	Oak Mfg. Co.	720-6
V1	Electrometer tube	Amplifier	Victoreen Instrument Co. VX86, 5886 Raytheon Mfg. Co. 5886	720-58
V2	Ionization chamber assembly	Detecting element	Victoreen Instrument Co. 720-20	720-20

Mechanical Components

Description	Function	Manufacturer & Part No.	Victoreen Part No.
Beta shield assembly	Covers chamber beta window	Victoreen Instrument Co. 720-45	720-54
Carrying strap	Shoulder strap	Keller Products	710-45
Carrying strap buckle (2)	Carrying strap length adjustment	Waterbury Buckle Co. 8075	710-44
Case bottom assembly	Bottom case of instrument	Victoreen Instrument Co. 720-46	720-46
Case clip (2)	Holds instrument sections together	Victoreen Instrument Co. 720-36	720-36
Case gasket	Water seal between case top and case bottom	Victoreen Instrument Co. 710-94	710-94
Case top and handle assembly	Top panel of instrument	Victoreen Instrument Co. 720-45	720-45
Circuit plate assembly	Supports components	Victoreen Instrument Co. 720-35	720-35
Circuit shield	Shields high impedance components	Victoreen Instrument Co. 720-44	720-44
Index ball	Beta shield detent	Victoreen Instrument Co. 720-31	720-31

Description	Function	Manufacturer & Part No.	Victoreen Part No.
Instruction manual (2)	Operating instructions	Victoreen Instrument Co. 720-2	720-2
Knob	Range switch knob	Harry Davies Molding Co.	9-9
Knob	Zero adjust knob	Harry Davies Molding Co.	9-14
Meter gasket	Water seal between case top and meter	Victoreen Instrument Co. 720-14	720-14
"O" ring	Water seal	Parker Appliance Co.	728-33
"O" ring (2)	Water seal	Parker Appliance Co.	46-38
Retaining ring (2)	———	Victoreen Instrument Co. 720-28	720-28
Spring	Grounds circuit shield	Victoreen Instrument Co. 720-47	720-47
Washer (2)	Electrical connection to spring	Victoreen Instrument Co. 720-48	720-48